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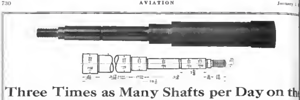

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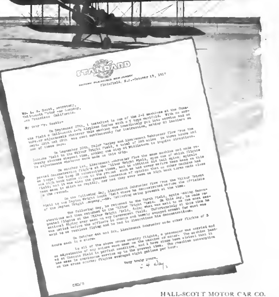

STANDARD
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Plainfield, N.J.—October 19, 1917

Mr. L. G. Scott, Secretary,
Hall-Scott Motor Car Company,
San Francisco California.

My dear Mr. Scott:—

On September 27th, I installed in one of the J-1 machines at the Chanute Field a Hall-Scott A-7a Airplane Engine with a Y type manifold. With no carburetor adjustments whatever this machine was immediately put into service and on Sept. 28th and 29th was used continuously for instruction, making 83 landings on one of these days.

On September 30th, Major Hanley and Lieutenant Schroeder flew from the Chanute Field to the Wilbur Wright Field, a total of 305 miles in three hours and twenty minutes elapsed time, making one stop at Middletown to inquire directions. No adjustments whatever were made on this trip.

On October 1st, Lieutenant Schroeder flew the same machine and made repeated demonstration flights at the Wilbur Wright Field, upon one of which flights he looped the loop 28 consecutive times, and in addition did tail spins, spirals and high bank turns close to the ground such as had never before been seen on this field; and it was also the general consensus of opinion that no other machine had been seen to climb as rapidly, nor had they ever seen as high bank turns made close to the ground.

On the following day, Lieutenant Schroeder flew from the Wilbur Wright Field to the Dayton Wright South Field where he demonstrated before the officials of the Dayton Wright Company,—Mr. Kettering being present at the time.

The following day, he returned to the North Field, again making demonstrations and then returned to the Wilbur Wright Field. On this day, he made repeated flights at the Wilbur Wright Field, doing what was said to be the most sensational flying ever seen on any Government field. Unfortunately at this time he was called before the officers in charge and barely escaped arrest for what was said to be reckless flying and he had to discontinue his demonstrations.

On October 4th and 5th, Lieutenant Schroeder made other flights of 3 hours each in a storm.

In all of the above cross country flights, a passenger was carried and no adjustments of any nature were made on the machine or motor. The machine landed at Chanute Field in perfect condition, and I have since been advised that it has been in continuous service up to the present time. The gasoline consumption on the cross country flights averaged eight gallons per hour.

Very truly yours,
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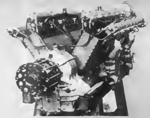

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AVIATION AND AERONAUTICAL ENGINEERING

VOL. III. NO. 11

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Vol. III January 1, 1918 No. 11

Seaplane Float Construction

By Charles G. MacGregor
Curtiss Aeroplane and Motor Corp

In the March 15, 1917, issue of AVIATION AND AERONAUTICAL ENGINEERING, an article by the writer dealt with the various forms of seaplane floats and their duties. To supplement this the following article will describe the construction of these floats, without going into the details too deeply, for the reason that each designer and builder has his own ideas as to how the minor points should be constructed. The following methods, however, have been found to be most practicable, and most of this construction has been accepted by the United States and other governments.

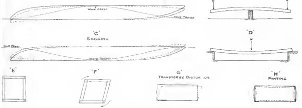


FIG. 1. STRAINS ON THE FLOAT

Strains on the Float in a Seaway

Longitudinal Strains.—When a seaplane passes from calm water into a seaway, the float or floats are subjected to certain strains due to the action of the waves. Suppose the float is headed end on to a series of waves whose lengths from crest to crest, or from trough to trough, equal the length of the float, then these strains reach their maximum.

Let us consider the two extremes under the above conditions.

(1) Suppose the float is supported in the middle on a wave crest and the ends unsupported by being in the trough; the consequence is, the ends will tend to droop relatively to the middle. This bending of the float is termed "Hogging" (Fig. 1-A). This condition, though only momentary, is comparable to a beam supported in the middle and weighted on the ends (Fig. 1-B). Under these circumstances the upper members of the structure of the float, such as the deck stringers, planking, etc., are in tension, and the lower members are in compression.

(2) Now let us consider the opposite extreme. As the waves travel along they reach a position where they support the two ends of the float, with the middle in the trough of the wave. In this condition the middle of the float will tend to droop relatively to the ends. This bending is termed "Sagging" (Fig. 1-C), and when in this condition the float can be likened to a beam supported at the ends and weighted in the middle (Fig. 1-D). Under these circumstances the lower members of the structure of the float, such as the keel, keelson, chine stringers, planking, etc., are in tension and the upper members are in compression.

Transverse Strains.—There are other strains tending to alter the transverse form of the float caused (1), by the seaplane rolling heavily, (2), by the seaplane making a skidding landing on the water, and (3), by the float being buried under a wave.

Take a square frame jointed at the corners (Fig. 1-E), and move it back and forward after the manner of a ship rolling (Fig. 1-F). The frame will distort, but will not break at the corners. This distortion is found in the float structure at the deck edge and chine corners (Fig. 1-G). Therefore, the construction at these points must be made very strong. The transverse bulkheads are most effective in preventing this racking.

The forward end of the float is subjected to severe blows from the waves, which tend to force the planking inward. This bending is termed "panting" and is taken care of by special stiffening, either by stringers or by transverse floors. Similarly the sides tend to work out and in, and the deck to sag by the weight of the water when buried in a wave (Fig. 1-H). The frames, floors and stringers resist this action and are therefore made sufficiently strong and are not spaced too far apart.

Construction

The construction of these floats must from the very nature of their work be very strong, and most important of all the lumber used must be of the very best that can be obtained, because each and every piece has to do its work almost to the limit of its strength, at the same time not a single ounce must be carried that is not absolutely required Undoubtedly the quality and nature of the wood used in their construction at the present time leaves much to be desired The builder is severely handicapped by being unable generally to get the most suitable wood. That obtained is often poor in quality, kiln-dried and improperly seasoned, delivery is uncertain, added to which the cost makes the purchase of the best almost prohibitive.

In the selection of lumber the greatest care is exercised as so much depends on the quality and strength of every part of each piece to do its allotted work under the most severe conditions. Lumber with knots and sap is never used, and great care is taken to see that none of the material is checked or has a twisted grain These are probably the most important defects looked for.

As there are two distinct forms of floats, it will be better to refer to them separately because of the differences in their construction. The flat side and flat deck float is known as a "Flatback," and the rounded topside float is known as a "Roundback" There are, of course, many similarities in their construction, such as the keel, keelsons, stringers, etc The principal difference in their construction is in the method of framing Framing is the first step in the construction, consisting of the keel, keelsons, chine stringers, deck stringers, frames, floors and bulkheads, in short, it is the skeleton of the float before it is planked and covered.

For convenience in framing and planking, boats of the type of canoes, launches and small sailboats are built upside down, and the larger boats are built right side up. Generally the floats are built in two operations, first right side up, and when fully framed on the bottom and fully framed and planked on the topsides, they are turned over on their backs to finish the bottom planking. This method is found to be most convenient as the whole structure is very rigid when it is loosened from the building mould, and there is little chance of the float changing shape.

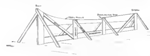


Fig 2 Building Mould

Keel Mould—This is the first erection in this process of building, and though not a part of the float it is nevertheless very important, as the whole hull is built on top of this, and great accuracy is necessary in getting it correct at first, because any mistakes made at this stage of the building will prove to be very costly if discovered after the framing is well advanced The mould of the keel is usually built of ⅞-in pine boards, with the upper edge cut to the form of the keel line This is supported above the floor by uprights at a suitable height for working, and is supported transversely by braces nailed to the sides at their upper ends and to the floor at their lower ends A simple form of building mould is illustrated in Fig 2

Keel—When a boat is being built the first part of the structure to be laid on the keel blocks is the keel This member is, broadly speaking, the backbone of the whole structure. The function of the keel is to assist in the stiffening of the hull longitudinally Such is the case with the seaplane floats, although in some of the later ones the keel has been dispensed with entirely, and a center keelson used in its stead. Then again the keel and the keelson are used in conjunction as will be shown later on When the seaplane is resting on the beach or deck of a ship, the weight of the whole machine is sometimes on the keel alone; one can, therefore, readily understand that this particular member must be very strong indeed.

Several forms of keels are shown in Fig. 3. In *A*, *B*, and *E*, the under surfaces are rabbeted to receive the bottom planking edges. The bottom planking is nearly always built double skin, and sometimes two rabbets are cut in the keel, one for the inner skin and one for the outer skin, as shown in *A*. In *B* the keel is rabbeted for the inner skin only, the outer one running down and butting at the center line, or running across from chine to chine without a break at the keel. *C* and *D* are inside the planking, the underside being beveled to the form The upper surface of *C* is cut out for the lower edge of the keelson and the edges are chamfered *D* is not used with the center keelson *E* is single rabbeted for both skins, the under surface projecting below the bottom planking from ½ to ⅞-in, thereby taking the place of the false keel This is strong but not very good practice on account of the wear on this part of the float unless it is protected by a strip of brass screw fastened to the under surface The keel is made in one continuous piece from stem to stern In fact all stringers and planking used in the construction of these floats are each made in one continuous length when possible as every piece is cut down to the minimum size to reduce weight, the addition of every butt, scarf and joint means the addition of weak points, more work and more weight

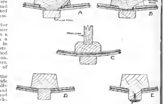


Fig 3 Keel Sections

The keel is fastened temporarily and firmly to the keel mould by means of wood cleats which grip the upper edge of the keel and are screw fastened to the mould.

The materials used in the keel construction are white oak, ash, Canadian rock elm and mahogany The two former are the most suited to this work; they are strong and will stand steam bending very well Elm is very troublesome to work and most difficult to keep in shape, it twists and warps so much. Mahogany is satisfactory for keels with easy curves where no steam bending is required

Scarfs—Before proceeding any further with the construction we will look into the manner of making these joints or scarfs most commonly used in float construction

Sometimes it is almost impossible to obtain certain lengths of lumber for planking or stringers, or it frequently happens that there is so much curvature in say a keelson, that to get it out of one piece would be well nigh impossible on account of the great width of board necessary, or on account of the cross grain at the ends. To overcome these difficulties it is necessary to make this particular part in two pieces. The joint of these two pieces is called a "scarf" Of these there are many varieties, but it is necessary here to mention only a few of those most commonly used in this class of work These are illustrated in Fig 4

The fastenings are copper tacks, rivets and burrs, and brass wood screws Where they come close together they are

kept out of the same line of grain by staggering. This is necessary to avoid, where possible, the splitting of the wood

A illustrates the short lap scarf, used mostly on planking. This is better made close to a frame, so that the frame can be used as part of the backing The back block is riveted to the frame side, and the ends project over about ¾ in so as to bear on the plank above and below the plank being scarfed The forward edge of the after piece of the plank is always on the inside The reason for this is that were it made with this edge outside the rush of the water along the planking would get under and rip the whole plank out, if it projected a little above the surface of the planking This edge is cut to a sharp edge and is covered by the backing block The edge of the front portion is cut off square to not less than 1/16 in and not more than one-fourth of the thickness of the planking Screws are the best fastenings for this scarf because the planking at this point is very thin, and there is plenty of thickness behind into which the screws can be driven to secure a good hold The surfaces are well covered with glue or varnish where they come in contact before fastening *B* shows another method of joining plank ends. It is quite satisfactory though not so light as *A* This is a square butt joint, backed by a slightly wider butt block than in *A*, wide enough on one side to take two rows of fastenings *C* is a method adopted in scarfing keelsons, etc., where the pieces being scarfed are not less than ½ in thick. The end of each piece is square as in *A* *D* is used in scarfing stringers, etc The two surfaces are joggled over each other, so that when they are riveted together and come under tension, they will hold, or "hook," and not slip This relieves the fastenings from shear In a case where the fastenings are not liable to come under shear, the plain scarf is sufficient, similar to *C* It is sometimes advisable to scarf the pieces on edge, such as is done in wide stringers and keelsons *E* illustrates this method Slipping is prevented either by the means adopted in *D*, or by the use of a dowel pin This pin is made of hardwood, is glued into one piece and tightly driven into a hole drilled in the other piece. The pieces are clamped and screw fastened and the ends and middle are strapped with light sheet copper. The heads of the nails securing the

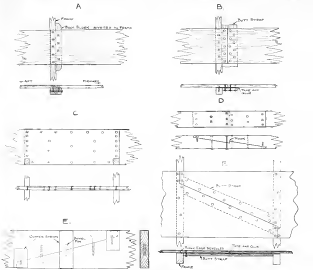


Fig 4 Scarfs and Plank End Joints

copper are soldered, to prevent working loose.

In laminated construction the scarf is arranged irrespective of the grain. Care is taken to arrange the scarf, or butt, so that it does not all come within one frame space. *F* shows how this is accomplished. The butt block or strap is of the same thickness and material as the planking and is riveted to it. Tape and glue are laid between to ensure water tightness. The edges of the planking where it butts are beveled to a slight angle instead of being made square.

Keelson.—The duty of this part is to assist the keel in stiffening the float longitudinally, and to strengthen the bottom to enable it to withstand the terrific impacts and pressure of the water. Sometimes only one center keelson is necessary, and then again one, two and even three side keelsons are used on each side of the keel or keelson between it and the chines (Fig. 5). The number used depends on the width of the bottom. The keelson is usually built of a thin board set up on its edge, the lower edge notched over the floors, and lightened by cutting holes or panels on each side between each floor (Figs. 5 and 6). The lower edge butting against the planking is held there by the wood screw plank fastenings. The upper edge is sometimes stiffened transversely by the addition of a cap strip. This piece is not necessary, provided the keelson is fairly thick, or if the unsupported span of the upper edge does not exceed 24 in. Sometimes stringers are used run along the inside of the bottom planking (Fig. 7). The keelsons are usually fitted after the bottom floors or framework are set up over the keel.

Where no keel is used, and the bottom planking runs across from chine to chine uninterruptedly, without any break at the centerline, the planking is screw fastened to the center keelson. When made thin and deep the following are used: white pine, white cedar, basswood, spruce, Port Orford cedar, yellow pine; when used as a stringer against the inside of the planking these are used: ash, white oak, mahogany, elm.

Floors.—The name given to this particular part of a boat is very confusing to one not familiar with boat or ship construction. These have nothing to do with decking or flooring directly, particularly so in the case of these floats. They are the cross frames or ribs of the bottom structure. Their duty is to assist the bulkheads in stiffening the bottom transversely. Each floor is made by either steam bending it to form (Fig. 6), or by cutting it out of a solid piece to the desired form (Fig. 7). When cut out of the flat board they can be lightened by holes, and between these holes chocking strips are glued and nailed

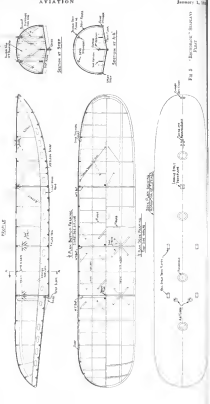


Fig. 5. "Bouncback" Seaplane Float

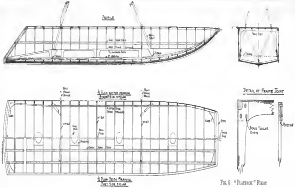


Fig. 6. "Flatback" Float

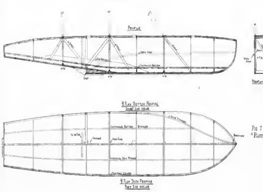


Fig. 7. Laminated "Flatback" Float

on each side (Fig 8) These are necessary to prevent the wood from checking or splitting between the holes, which would undoubtedly happen when the wood dried out Cap strips are sometimes fastened to the lower edge of the solid floors if made of pine or other soft wood (Fig 8) This prevents splitting or checking of the floor and makes something firm into which to screw the plank fastenings. These cap strips are also used where an extension of the bottom is required by the side fins (Fig. 8). This illustration also shows the laminated floor construction The upper edge has a stiffener fastened on with screws, the lower edge has a strip of ash or oak attached, to which the bottom planking is fastened, with the ends fastened to the side frames and chine stringers. A short vertical stiffener is fixed at the center line between the keel and the cross stiffener on the upper edge. The extremities are cut higher so as to form knees at the chines. The side frames are attached to these with hollow brass tubular rivets.

The materials used in floor construction are oak, ash, mahogany, Spanish cedar, white pine, spruce, Port Orford cedar, and sometimes basswood. Laminated wood is made in sheets of the following alder, birch and Spanish cedar

Stem.—This part of a boat is generally a vertical member, but in most of the floats built in this country it is a distinct departure from this type. It is just a continuation of the chine or deck stringers bent around to the desired curvature (Fig 5), or it may take the form of a wood block, rabbeted for the planking ends, and into which the stringer ends are notched and fastened, reinforced in the corners by oak knees (Fig 6). An additional piece is attached to the bent stem inside for the towing fittings. In the vertical stem construction (Fig 7) the keel is continued right up to the deck, and riveted to the deck stringers with a breasthook or knee between.

The materials used in their construction are white oak, ash, Canadian rock elm for steam bending, and yellow pine and mahogany for the solid stem

Sternpost—These are similar to the stems in construction and material Oak knees are used to brace the corners. Occasionally a transom or flat board stern is used by some builders (Fig 7). This type of stern increases wind resistance and is not so light in construction as when the planking runs down to the sternpost without a break The same applies to the stern illustrated in Fig 7 An advantage claimed for the transom stern is that should the seaplane be afloat and drifting sternwards with the wind without having the sea anchor out, the water is not so liable to climb aboard, and thus tend to tip the machine over on its back

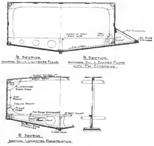


FIG. 8

Chine Stringers—The chine is the name given to the sharp corner at the junction of the bottom and sides of the float. Along this edge a stringer is run to support the edges of the

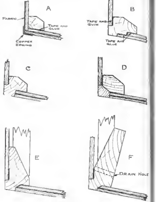


FIG 9 CHINE STRINGER SECTIONS

side and bottom planking This is called the chine stringer and is made in various forms, the commonest of which are illustrated in Fig 9 *A* is the simplest, but the plank edges are only protected by a thin copper strip By cutting a rabbet as shown in the remainder of the sections, the construction is improved, although it is more costly and troublesome to make A double rabbet as in *B* is not essential when the planking is so thin, so that it is seldom used in float construction These stringers run in one piece along the sides to the stem and sternpost, and where a bent stem or sternpost is used, they are scarfed together just about where the straight of the sides ends, as shown on construction plan (Fig 5) *C* shows the simple single rabetted chine stringer and *D* shows the built-up type The inner portion is bevelled for the plank landing, and the outer piece is riveted to it between the plank edges Should the chine get cut up by rubbing or striking any objects, this can easily be mended by moving this piece without disturbing the planking *E* is a type of chine used in some roundbacks. It is deep and bevelled on the inside so that the frame heels can be riveted thereto *F* shows another type of chine stringer made specially deep to which the main struts are attached, the frame heels are riveted to the outer side between it and the planking This is difficult to build, but is very efficient in service Lumber or drain holes are cut between each frame so that water cannot lodge in the pockets formed between them.

(*To be continued*)

Computation of Airplane Climb*

The altitude, at any time, of an airplane climbing at its maximum possible rate, is very nearly represented by a mathematical law similar to that for the rise of electric current in an inductive circuit Thus if h be the altitude at a time, t and H the "ceiling" of the machine, we have the relation

$$h = H\left(1 - e^{-\frac{t}{T}}\right) \qquad (1)$$

where e is the base of the natural or Napierian logarithms and T is a time, which, by analogy with the electrical case, may be called the "time constant" of the climb, being the time required by the altitude to become $1 - \frac{t}{T}$ or 632 of its final value, i e, for the airplane to rise to a height equal to 0 632 of its ceiling † Except that h and H and also t and T must be measured in the same units of height and time respectively, there is no restriction in this formula on the actual units used

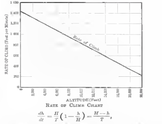
This being the case, it is possible to find expressions for the rate of climb at any time and at any altitude, and also an expression for the ceiling of the machine, which latter is quite simple We will first show how to obtain such expressions from the equation already given, and afterward will give the application of these to a practical case

The rate of climb is obtained by differentiating h with respect to t, and is

$$\frac{dh}{dt} = \frac{H}{T} e^{-\frac{t}{T}} \qquad (2)$$

which is an equation giving the rate of climb in terms of the time, the ceiling, and the time constant.

By eliminating the exponential $e^{-\frac{t}{T}}$ from equations (1) and (2), we obtain an equation giving the rate of climb in terms of the altitude, the ceiling, and the time constant This equation is



RATE OF CLIMB CHART

$$\frac{dh}{dt} = \frac{H}{T}\left(1 - \frac{h}{H}\right) = \frac{H - h}{T},$$

and shows that rate of climb plotted against altitude is a straight line. If we call rate of climb r we have

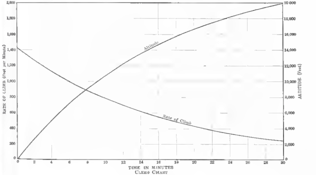
$$rT = H - h$$

or

$$\frac{h}{H} + \frac{r}{H/T} = 1 \qquad (3)$$

which equation shows that when r is plotted against h, the intercept (H) of the straight line on the altitude axis is the ceiling of the machine (where rate of climb $r = o$) and the intercept $\left(\frac{H}{T}\right)$ on the rate of climb axis is the initial rate of climb, (i e, rate of climb when $h = o$)

* From *Flight* (London)
† The time required to rise to the ceiling is mathematically infinite



CLIMB CHART

The simple expression for the ceiling of a machine is obtained as follows

After any time t from the start let the observed altitude of the airplane be h_1, and after a time $2t$ let it be h_2. Then we have

$$h_1 = H\left(1 - e^{-\frac{t}{T}}\right)$$
$$h_2 = H\left(1 - e^{-\frac{2t}{T}}\right)$$

Let us write X for the exponential $e^{-\frac{t}{T}}$ for convenience, then.

$$h_1 = H\ (1 - X)$$
$$h_2 = H\ (1 - X^2)$$

whence by division $\dfrac{h_2}{h_1} = 1 + X$

but since $\dfrac{h_1}{H} = 1 - X$

$$\frac{h}{H} = 2 - \frac{h}{h_1}$$

and $H = \dfrac{h_1}{2 - \dfrac{h}{h_1}}$

which gives the ceiling of the machine in terms of the altitude h_1 at time t and the altitude h_2 at time $2t$ (Note that t may be any time whatever during the climb) So all we require, to calculate the ceiling of a machine, is the altitude after any time, and the altitude after double that time

We will now illustrate the foregoing analysis by a practical example Observations of a certain airplane on a climb test showed the altitude to be related to the time after start according to the following table

Time (minutes)—									
0	2 5	5 0	7 5	10 0	12 5	15.0	17 5	20.0	22.5
Altitude (feet)—									
0	3300	6150	8730	10760	12610	14190	15530	16650	17600

The ceiling of the machine may be calculated right away taking h_1 as 10760 ft. after 10 minutes and h_2 as 16650 ft. after 20 minutes. We have

$$H = \frac{10700}{2 - \frac{16650}{10760}}$$
$$= \frac{10760}{4526} = 23{,}770 \text{ feet}$$

We may next calculate T, the time constant. The value of the exponential (which we called X for short) is (when $t=10$ minutes)

$$X = \frac{h_2}{h_1} - 1 = \cdot 5474$$

hence $-\dfrac{10}{T} = \log e \cdot 5474$

$$= 2\ 3026 \log_{10}\ 5474.$$

whence $T = \dfrac{10}{2\ 3026 \times\ 2617} = 16\ 60$ minutes.

The initial rate of climb

$$= \frac{\text{ceiling}}{\text{time constant}} = \frac{23770}{16\ 60}$$
$$= 1432 \text{ feet per minute}$$

Having calculated the constants of the climb, we may now write down the equations for the altitude at any time, the rate of climb at any time, and the rate of climb at any altitude. They are respectively —

$$h = 23770\left(1 - e^{-\frac{t}{16\ 66}}\right)$$
$$r = 1432\, e^{-\frac{t}{16\ 60}}$$

and $r = \dfrac{23770 - h}{16\ 60}.$

From the first two equations the altitude and rate of climb at any time t are calculable and the figures for the altitude are found to agree closely with the table already given, so far as this table goes We give below a table calculated from these two equations, also a table showing rate of climb at various altitudes. The results are also plotted in the accompanying curves

Time (minutes)—						
0	2 5	5.0	7.5	10 0	12.5	15.0
Altitude (feet)—						
0	3320	6180	8640	10750	12575	14140
Rate of Climb (feet per minute)—						
1432	1232	1060	911	784	674	580
Time (minutes)—						
17 5	20 0	22 5	25 0	27 5	30 0	
Altitude (feet)—						
15485	16645	17640	18500	19240	19870	
Rate of Climb (feet per minute)—						
499	429	369	318	273	235	

Altitude (feet)—					
0	2000	4000	6000	8000	10000
Rate of Climb (feet per minute)—					
1432	1311	1191	1070	950	829
Altitude (feet)—					
12500	14000	16000	18000	20000	
Rate of Climb (feet per minute)—					
709	588	468	348	227	

Book Reviews

"How to Fly," by Captain D Gordon E. Re Vley Paul Elder & Co , San Francisco, $1, 100 pp

This attractive little book of pocket size, intended for the guidance of the prospective aviator, is written in clear and concise language by a practical pilot

The author advocates the single system of training which is practised principally in France, as against the dual control system. He contends—and the brilliant legion of French aviators appears to bear out his statement—that the pupil who learns to fly in a series of graduated flights on the field and over the field, after he has properly grasped the maneuvre of the airplane, quickly develops a tendency to rely on his own ability rather than on the help of the instructor—a tendency likely to be bred by the dual training system

It is obvious that a pupil trained with the single system becomes much more quickly self-reliant and efficient to counteract such eventualities as may occur to him in flight, because he has acquired his knowledge of atmospheric conditions by practical experience.

His theory, "Do not rush students through their training —give them from six to nine months of instruction Haste makes waste, and the results cannot fail to justify the means" is quite self-explanatory, although the time limit given may appear somewhat excessive under wartime conditions.

The various phases of the single-training system, as well as the requirements for obtaining the pilot, expert aviator and R M A certificates are dealt with in a simple yet comprehensive manner

The Eyes of the Army and Navy, by Flight Lieut Albert H. Munday, R N A. S (Harper & Bros. 227 pp , $2 00 in flexible leather, $1 50 in cloth)

Mr Munday has written from the standpoint of a practical aviator, and it is hard to imagine a work better suited to be used as a textbook by the embryo military or naval aviator. The book is impossible to review in a conventional fashion, as it is made up of more than a dozen almost unrelated parts, a chapter apiece being devoted to subjects so widely diverse as navigation theory of flight, wireless telegraphy meteorology, engines, and photography

As might be expected, the most authoritatively treated subjects are those which relate most closely to the daily work of Mr Munday as a service pilot Artillery observation, the care of machines, and aerial fighting, for example, are discussed with a clarity and, so far as military exigencies and the Defense of the Realm Act permit, with a completeness which leaves nothing to be desired The theory of flight is somewhat confused by the attempt to relate it to fundamental dynamical principles, involving a discussion of the air flow about wings, the downward momentum imparted to the air, etc.

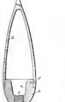
A particularly commendable feature in a book of this type is that it has been written with a minimum of formulæ.

Aircraft Bombs*

By Justin Lauvergne

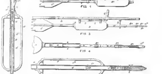
The missiles which were dropped from aircraft in the early part of the Great War were, for the greater part, bombs and grenades of obsolete types which had been formerly employed in field warfare Their action was rather uncertain and their manipulation was often fraught with considerable danger

A short time before the war broke out, the Vickers Works of England had, however, patented two types of aircraft bombs which were provided with a safety device that prevented their



The Kunkler Bomb

a Revolving Vane b, Head Piece c Threaded Detonator Socket d Set Screw e Body of the Detonator g, Body of the Bomb



Vickers Pilot Bombs

Fig 1—The Bomb Suspended from the Airplane Body Fig 2—Longitudinal Cross Section of the Body of the Bomb. Fig 3—Side Elevation of a Collapsible Model of Pilot Bomb Fig 4—Longitudinal Cross Section of a Collapsible Pilot. Fig 5—Longitudinal Cross Section of the Body of the Bomb with Collapsible Elements Compressed

Figs 1 2—a, Firing Charge; a_1, Pilot; a_2, Tail Piece; a_3, Shell of the Bomb; b Locking Spindle; b_1, Airplane Body; b_2, Sliding Rod; b_3, Eye; c, Release Lever; c_1, Firing Pin; c_2, Spring Loaded Hammer; c_3, Spring; c_4, Stop; d_1, Tubular Firing Pin Guide; d_2, Point of Pilot Rod; d Percussion Cap; d_3, Explosive Charge; d_4, Stabilizing Fins; d_5, Parachute Cords.

Figs 3 4 5—a, Pilot Rod; a_1, Longitudinal Cross Section of Collapsible Rod; a_2, Spring Loaded Claws; b, Spindle; c_1, Firing Pin; a_3, Shell of the Bomb; c, Firing Charge; d_1, Forward End of Tube a_1; d_2, Explosive Charge

Pilot Bomb with Parachute

A Body of the Bomb B, Parachute C, Pilot Cord or Rod D Position of the Spring Which Is Tensioned by the Pilot P Pilot.

premature or accidental explosion The destructive effect of these bombs also greatly exceeded that obtained with old-type missiles.

In the first type Vickers bomb, the firing charge is held remote from the explosive charge until after the launching, and means are provided to cause the bomb to explode at a previously determined distance from the ground or the target For the latter purpose, the bomb is fitted with a "pilot" consisting of a metallic mass, which is suspended from the body of the bomb by a chain or a wire the tension of this pilot cord is increased by a parachute, which slows down the bomb's vertical speed The pilot cord is wound around a drum which is connected with an aerial propeller, the latter being set in motion through the tension of the cord When the cord is entirely unwound, the spring of the percussion needle is, therefore, held in place only by the weight of the pilot, so that as soon as the latter strikes its objective the spring is released and drives the needle into the percussion cap of the firing charge, which in its turn acts on the explosive charge. The height at which the bomb is made to explode over a target is, consequently, determined by the length of the pilot cord, and can thus be adjusted at will.

In another type, the mass of the pilot is composed of a cartridge with its percussion fuse and cap, and a fuse takes the place of the cord On striking the target, the cartridge sets fire to the fuse, and this, in its turn, sets fire to the detonating charge The latter object can also be attained by passing an electric current through the pilot, the current being furnished by accumulators housed in the bomb The pilot cord is formed

FIG 1 FIG 2

The Kunkler Detonator

Fig. 1—Before the Release Fig 2—After the Release e, Head f Cap Holder g, Firing Pin hh, Springs k Plug; l Percussion Cap i Groove mm Outer Springs nn Inner Springs. Clamping Cap Holder After the Outer Springs Are Unlocked

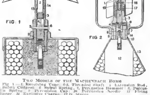


FIG 1 FIG 2

Two Models of the Machenbach Bomb

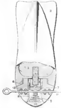
Fig 1—1 Revolving Vane 2-3, Threaded Shaft 4 Extension Rod, 5 Safety Gudgeon 6 Spiral Spring, 7, Percussion Hammer 8, Percussion Spring 9 Percussion Cap 10 Percussion Needle 11 Firing Charge 12 Explosive Charge 13 14 Sleeve

Fig 2—13 14 Sleeve 7, Percussion Hammer, 8, Safety Spring 9, Percussion Cap 10 Percussion Pin, 11, Firing Charge 1 Revolving Vane 2 Revolving Shaft, 4, Pin 5 Safety Gudgeon 6 Spring 15, Lock Nut 17, Mobile Shaft, 19, Guide Screw 20, Screw 21 Spring, 22 Cap

* Abstract from Science et la Vie

of two conducting wires, the mass of the pilot closing the current on contact with the ground. The charge is set on fire either by a spark or by an electro-magnet actuating the percussion needle.

In another type of bomb, also manufactured by Vickers, the pilot consists of a rod, which is carried through the body of the bomb in the longitudinal axis, a tail piece carries in the rear the firing charge and stabilizing fins. The rod rests in a suitable guide, which is locked when the bomb is inactive, but through which it is permitted to slide when the lock is removed. The firing charge is thus kept far apart from the explosive charge, so that even an accidental discharge of the firing charge is not likely to endanger the lives of the crew.



THE PUTSCHER BOMB

1 Body of the Bomb; 2, Stabilizing Fin; 3 Explosive Charge; 4 Firing Charge; 5 Percussion Hammer; 6 Fuse Channels; 7, Firing Caps; 8 Friction Head; 9, Spring; 10, Plug; 11 Safety Spindle; 12 Ball Bearings.

The bomb is suspended underneath the airplane in a horizontal position. By operating the lever which releases the bomb the safety lock is automatically removed and, as the bomb gradually assumes a vertical position, the pilot rod slides forward, and carries the firing charge into the center of the explosive charge. A spring-loaded percussion needle then slides into a suitable aperture provided for in the tail piece of the bomb and is ready for action. When the pilot rod hits the ground, the impact makes it slide back in its guide, the firing charge is thus brought in contact with the needle and the explosion follows. To insure the free fall of the pilot rod when the bomb is released, the progress of the bomb is retarded by a parachute, while its course is steadied by stabilizing fins provided on the tail piece. In some models the pilot rod is composed of a number of telescoping tubes, which develop their whole length under the gravitational speed. The telescoping

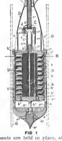


FIG 1

FIG 2

THE BERGERY DEROCLE REBOUNDING BOMB

Fig 1 — Longitudinal Cross Section. Fig 2 — Transverse Cross Section

A Fusing a Head Piece, a_1 Tapered Part of Casing, a_2 Collar, a_3, Firing Charge, B Hollow Cylinder, b_1 Projectile Ports, b_2 Projectiles, b_3 Projectile Retaining Sleeve, b_4 Catches, b_5 Plug, b_6 Firing Pin, b_7 Tube; b_8 Ports. C Detonator; c Detonator Guide, c_1 Firing Cap, c_2 Firing Pin Sliding in Tube c_3, c_4 Spring, c_5 Head of Rod. D Shell Provided with Ports d. E, Stabilizing Fins Held in Position by Nut e. G, Launching Tube

elements are held in place, after they have reached their full development, by suitable block-devices.

In the Kunkler bomb the safety device is based on the action of the centrifugal forces developed during the fall of the bomb. For this purpose the bomb is provided, at the rear, with an aerial propeller which imparts to the bomb a rotary motion. The firing charge is lodged in the head of the bomb, in a detonator, where it is held apart from the needle by means of two spring loaded masses. As soon as the centrifugal force acquires a certain magnitude, the masses will overcome the force of the springs and move toward the periphery of the bomb, thus freeing the firing charge which is then held in place only by two clamps. On striking the ground the clamps will give way and drive the firing charge into the percussion needle.

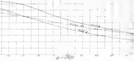
The bomb patented by Richard Machenbach and the Carbonit Sprengstoff A G of Germany is a missile fitted with rotating fins, which answer the double purpose of stabilizing its path and of unlocking the firing mechanism only after the bomb has travelled a certain distance, thus insuring the safety of the manipulants. Although this is no novel principle, the patentees claim for their bomb a greater simplicity and a more efficient control than hitherto attained. The firing mechanism is provided with a further safety device in so far as the aerial propeller which unlocks the firing pin is allowed to rotate only after a given time has elapsed from the moment the bomb is released. The working of this bomb, two types of which are shown, are obvious from the accompanying diagrams.

In the Putscher bomb the firing mechanism is actuated, like in the foregoing types, by direct impact. The fuse is set on fire by means of friction firing caps and the spring of the firing pin is blocked by a safety spindle, which must be removed before the release of the bomb.

The Bergery Derocle bomb, which has been described in *Schuss und Waffe*, is of the rebounding type. The bomb consists of an external casing which is closed on its lower end and houses the body of the bomb proper. On striking the ground the case, which carries the firing charge, acts like a mortar and imparts to the bomb proper a force opposite to that of its trajectory, causing it to rebound upon striking the target. The external and internal portions of the bomb are kept in their relative position, up to the moment the impact occurs, by suitable catches. When the outer case strikes the ground its motion is annulled, but the bomb proper, having a considerable inertia, will tend to continue on its path. The force thus generated unlocks the catches and drives the bomb with its firing pin against the detonating charge contained in the outer case, which then shoots out the bomb proper like a projectile is fired from a gun.

A New Method of Plotting Wing Characteristics

E. P. Warner suggests the plotting of L/D against $\frac{K_y \text{ max}}{K_y}$ and this is done for several sections in diagram. This is really the equivalent of plotting against the speed range ratio, since $K_y A V^2$ is always constant, and the speed of flight for any given value of K_y is equal to the speed corresponding to the maximum value of K_y (or, in general, the minimum speed



of the machine) multiplied by the square root of the ratio of the two lift coefficients under consideration, and it is, therefore, possible if a given landing speed is required and a known maximum to read directly the L/D obtainable at the maximum speed with a number of different sections, without any further effort than that required to find the ratio of the speeds in question.

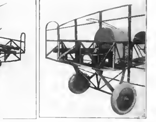
The chart has not been carried out for values less than 1.5. Such an extension would only prove deceptive, as the minimum speed for a machine flying very nearly "tangent" is determined, not by the maximum value of K_y, but by the second intersection of the "power required" and "power available" curves.

The Lanzius Speed Scout

The Lanzius speed scout is, unlike most present day airplanes, a machine in which the incidence of the wings may be altered in flight at the will of the pilot.

Such an idea is not wholly new. Aeronautical investigators have predicted for years such a possibility. Indeed, Captain Duchêne in his celebrated work, "The Mechanics of the Airplane," dwelt with considerable force on this subject, and prophesied the adoption of the principle of variable incidence in future machines, to reduce or augment the drag which would give the pilot opportunity to check or increase his speed. He pointed out that existing difficulties "may be eventually overcome by the invention of the variable surface machine, which would permit a high speed to be maintained

SKELETON OF LANZIUS SPEED SCOUT



THE FRONT SECTION

in normal flight while starting and landing could be accomplished at slow speed."

A machine based on this principle was produced in 1912 by Paul Schmitt, a Russian engineer living in France, and fully proved the correctness of the theory of variable incidence. This machine broke at the time several world's records for flights with five and more passengers. (A description of the Paul Schmitt airplane appeared in the Oct. 1, 1917 issue of AVIATION AND AERONAUTICAL ENGINEERING.)

George Lanzius, a Hollander, who was working on this very theory at that time and built models of the same as early as 1911, continually improved his designs until during the early part of 1917 he constructed a machine incorporating these features, which was successfully demonstrated in flight.

The outstanding features of this machine are —

1—A cantilever frame, rigidly constructed to support the planes.

2—Planes pivoted in frame capable of being operated by pilot from 0 to 15 deg.

3—Ailerons pivoted on plane tips under the angle of about 15 deg., movable in opposite directions transverse to the planes.

4—A distinctive system of lateral control.

The machine is entirely built of steel, except for the wing frames. No wiring is used in the construction of the body, all members being joined by riveting. The cantilever frame is built up of streamlined tubing and the wings are pivoted on this frame at the will of the pilot by means of a fixed worm-gear.

The wings are built up in the usual way of wooden frames and are covered with fabric. The drift wires do not run, as herewith shown, to the radiator frame but are fastened to the upper longerons of the body. The skeleton of the machine, as illustrated, weighs complete 380 lb.

The under carriage is built up of streamlined V-struts and is equipped with resilient Ackerman wheels, which obviate the necessity for special shock absorbers. The control is of the stick type.

The characteristics of the Lanzius Speed Scout, as furnished by the manufacturer, are the following:

Span, upper plane	29 ft.
Span, lower plane	24 ft.
Chord, upper plane	4 ft.
Chord, lower plane	3 ft. 6 in.
Overall length	24 ft.
Overall height	8 ft. 6 in.
Weight, empty	1200 lb.
Weight loaded	1800 lb.
Engine Sturtevant	210 h.p.
High speed	140 m.p.h.
Low speed	40 m.p.h.
Fuel capacity	4 hrs.

Aeronautical Patents

ISSUED NOVEMBER 20, 1917

1,246,020—To Glenn H. Curtiss, Buffalo, N. Y., assignor to Curtiss Aeroplane & Motor Corp. Landing gear for aircraft.

1,246,021—To Nelson W. Dalton, Buffalo, N. Y., assignor to Curtiss Aeroplane & Motor Corp. Streamlined shock absorber.

1,246,022—To Nelson W. Dallan, Buffalo, N. Y., assignor to Curtiss Aeroplane & Motor Corp. Airplane motor support.

1,246,023—To Charles B. Kirkham, Buffalo, N. Y., assignor to Curtiss Aeroplane & Motor Corp. Aerial propeller fastening.

1,246,024—To Henry Kleckler, Buffalo, N. Y., assignor to Curtiss Aeroplane & Motor Corp. Airplane furniture.

1,246,025—To Henry Kleckler, Buffalo, N. Y., assignor to Curtiss Aeroplane & Motor Corp. Dual interlocking control.

1,246,026—To Henry Kleckler, Buffalo, N. Y., assignor to Curtiss Aeroplane & Motor Corp. Tail-skid clip.

1,246,027—To Henry Kleckler, Buffalo, N. Y., assignor to Curtiss Aeroplane & Motor Corp. Airplane control surface.

1,246,028—To Henry Kleckler, Buffalo, N. Y., assignor to Curtiss Aeroplane & Motor Corp. Airplane wing hinge.

1,246,874—To Everard Richard Calthrop, London, Eng. Parachute.

1,247,412—To Simon Lake, Milford, Conn. Flying machine.

ISSUED NOVEMBER 13, 1917

1,246,235—To Newins B. Converse, Fresno, Cal., assignor to himself as trustee. Balancing device for flying machines and the like.

1,246,311—To Arthur Timothy O'Leary, Butte, Mont. Airplane.

ISSUED DECEMBER 4, 1917

1,248,545—To Hans J. M. Rasmussen, Chicago, Ill. Airplane.

ISSUED DECEMBER 11, 1917

1,249,593—To Frank A. Bullington, Portland, Ore. Airplane.

1,249,829—To Frank J. Reynolds, Rantoul, Ill. Safety navigable marine parachute.

1,250,033—To Roy B. Scroggs, Eugene, Ore. Airplane.

International Aircraft Standards

(Continued from last issue)

2W1—Mill Specifications for Aircraft Douglas Fir

REGION.—1 All Douglas fir lumber used in the production of this material shall have grown in the north Pacific coast timber region of western Oregon and Washington and nearby regions of British Columbia.

TIMBER.—2 The trees used in the production of the lumber shall be preferably of the "young yellow fir" type and shall be in a healthy condition at the time of felling. Brashy lumber characteristic of old overmature, or decadent yellow fir trees will not be accepted.

LOGS.—3. The logs from which the material is produced shall be preferably "butt" logs, and in no case shall "top" logs be used.

GRAIN.—4 All grain shall be straight, that is, the angle of deviation from a line parallel with the edges shall not exceed 1 in 30 (1.30) on surface with diagonal grain and 1 in 20 (1 20) with spiral grain. Stock 4 in. and thicker may be flat grain and stock less than 4 in thick shall be vertical grain.

TEXTURE.—5 (a) The wood shall be strong, tough and elastic. Brashy pieces will not be accepted.

(b) The rate of growth of any piece shall not be less than 30 annual rings to each 3 in. (76.2 mm.) when measured in a radial direction on either end section through the zone of maximum growth. Furthermore, no single in. (25.4 mm.) shall have less than 8 annual growth rings.

KNOTS AND BURLS.—6. (a) Not less than 80 per cent of the total footage of each shipment shall be free from knots of all kinds, and from burls, curly, gnarly, and irregular grain, on all four sides of each piece.

(b) In the pieces comprising the balance of the shipment (20 per cent or less) knots and burls or other irregularities of grain and other defects will be allowed, provided that the buyer is able to obtain cuttings from each piece which are clear, sound, straight-grained, and not less than 5 in (127 mm) wide and 16 ft (4.88 m) long. Not more than 25 per cent of the total volume of each piece shall be discarded in sawing out cuttings.

PITCH POCKETS.—7. (a) One pitch seam or pocket not to exceed 2 in. (50.8 mm.) long or its equivalent in minor pockets (provided they are not in the same annual ring) will be allowed in either or both faces of each piece 16 to 31 ft. (4 88 to 9.45 m) long and two such pockets or their equivalent in either or both faces of each piece 32 to 40 ft (9.75 to 12.19 m) long. Pieces shorter than 16 ft (4.88 m) and pieces narrower than 6 in (152.4 mm) shall be free from pitch pockets.

(b) Pieces having pitch pockets too large or too numerous to be allowed as defined in paragraph 7 (a) will be inspected in the same manner as for knots and burls as specified in paragraph 6 (b).

SAP.—8. Bright sap will be allowed in any piece, provided it does not extend more than one-fourth the width of the piece or one-third its length.

ROT AND SHAKES.—9 All pieces shall be free from rot, shake, dote, red heart, purple heart, and all other forms of decay.

TOOL MARKS AND OTHER DEFECTS.—10 Pieces must be free from pickaroon holes, hook marks, and other defects caused by handling tools, and equipment.

WANE.—11 Wane will be allowed on occasional pieces, but in no case shall it exceed either one-fourth the thickness, one-eighth the width, or one-sixth the length of the piece.

DIMENSIONS.—12. Percentages of various thicknesses, widths, and lengths, and the respective percentages of flat and vertical grain stock to be supplied are subject to special arrangement between purchaser and contractor at the time prices are fixed.

TOLERANCES.—13. (a) Thickness may be scant not to exceed one-eighth in (3 18 mm) on occasional pieces. If more than one-eighth inch (3 18 mm.) scant they will be accepted at contractor's option and tallied in the next inch class below.

(b) Widths may be scant not to exceed one-fourth inch (6.35 mm) on occasional pieces. If scant more than one-fourth inch (6 35 mm.) they will be accepted at contractor's option and tallied in the next inch class below.

(c) Lengths may be scant not to exceed 2 in (50 8 mm) on occasional pieces. If scant more than 2 in. (50 8 mm) they will be accepted at contractors option and tallied in the next 1 ft class below.

LOADING.—14 Shipment is to be loaded and covered in the manner prescribed by the purchaser.

3S22—Specifications for Mild Carbon Steel Tubes

GENERAL.—1 The general specifications 1G1 shall form, according to their applicability, a part of these specifications.

USE.—2 These tubes are suitable for all parts not heavily stressed, such as trailing edges and stiffeners.

MATERIAL.—3 The I A S B standard steel No 1020 shall be used. The composition is as follows

	Per cent
Carbon	0 15-0 25
Manganese	.30-.60
Phosphorus maximum	.045
Sulphur maximum	.050

MANUFACTURE.—4 The tubes are to be of the cold drawn seamless type and are to be furnished annealed.

Any tube may be rejected at any time because of injurious defects or faults in the steel which are revealed by manufacturing operations, notwithstanding the fact that it has previously passed inspection. Such rejected material shall be returned to the manufacturer at the latter's expense. This clause shall not be taken to apply to materials fabricated after export.

WORKMANSHIP AND FINISH.—5. The tubes are to be smooth, of the section specified, and within the tolerances, as to wall thickness, of uniform diameter, free from cracks, specks, longitudinal seaming, lamination grooving, and blistering, both internally and externally.

PHYSICAL PROPERTIES AND TESTS.—6. The tubes shall have the following physical properties

Tensile Test.—(a)

Minimum tensile strength 60 000 lb per sq in (42 18 kg./mm.²)

Minimum yield point, 36 000 lb per sq in (25 31 kg./mm.²)

Minimum elongation 25 per cent in 2 in (50 8 mm.), or 10 per cent in 8 in. (203 2 mm.)

Crushing Test.—(b) The test specimen shall be crushed endwise until the outside diameter is increased in one zone 25 per cent, or until one complete fold is formed. The specimen shall stand this treatment without cracking.

SELECTION OF TEST SPECIMENS.—7 One test specimen for the tensile test shall be chosen from every 400 ft (121 9 m.) of tubing and one test specimen for the crushing test from every 100 ft. (30.5 m.) of tubing.

The specimens for the crushing test shall have a length of 1.5 times the diameter of the tube.

Whenever possible the selection of the specimens shall be made by heats.

DIMENSIONS AND TOLERANCES.—8 (a) The following tolerances will be allowed on the outside diameter of tubes

Tubes under 1 5 in (38 1 mm.) diameter, ± 0 003 in (0 08 mm.)

Tubes over 1 5 in (38 1 mm) diameter, ± 0 005 in (0 13 mm.)

The manufacturer and purchaser shall agree upon tolerances for coalescent or telescoping tubes.

(b) The variation in wall thickness may be ± 10 per cent of the dimension specified.

(c) In no part of any tube shall the departure from straightness exceed 1 in 600.

DELIVERY, PACKING, AND SHIPPING.—9 All tubes shall be well oiled and delivered in boxes not exceeding 220 lb (100 kg) gross weight.

3N3—Specifications for Phosphor Bronze Castings for Bearings

GENERAL.—1 The general specifications 1G1 shall form according to their applicability, a part of these specifications.

USE.—2. This material is suitable for liners in babbitted bearings.

MATERIAL.—3 The chemical composition shall be as follows

	Per cent
Copper	79.00-81.00
Tin	9.00-11.00
Lead	9.00-11.00
Phosphorus	0.10-0.30
Total impurities maximum	0.25

MANUFACTURE.—4 (a) The material shall be made from lake or electrolytic copper conforming to the I A S B specification 2N2 and from pig tin at least 99 per cent pure.

(b) No scrap shall be used other than that produced in the manufacturers' own plants and which is of the same composition as the material specified.

WORKMANSHIP AND FINISH.—5. Castings shall be homogeneous and free from shrinkage cracks, spongy spots, blowholes, and foreign matter. Castings in which defects are revealed by machining operations shall be replaced by the manufacturer. The full weight of the original material in rejected castings shall be returned to the manufacturer.

DIMENSIONS AND TOLERANCES.—6. Castings must be true to pattern, cores must be correctly placed. Surfaces which are to be machined shall admit of finishing to the required dimensions without leaving any trace of the original surface.

3S20—Specifications for Cold Rolled or Drawn Carbon Steel Bars

GENERAL.—1 The general specifications 1G1 shall form, according to their applicability, a part of these specifications.

USE.—2 These bars are suitable only for low stressed parts.

MATERIAL.—3 The material for these bars shall be chosen from the I. A. S. B. standard carbon steels listed below. The composition shall be stated by the manufacturer or contractor, and is further limited as follows: Carbon, not over 0.25 per cent.

MANUFACTURE.—4. The steel shall be manufactured, or at least finished by the open-hearth electric-furnace, or crucible process.

WORKMANSHIP AND FINISH.—5 (a) The bars are to be bright and clean, sound, straight free from pipes, laps, cracks, twists, seams and damaged ends and are to have a workmanlike finish. They are to be uniform in quality within the stipulated margins of manufacture capable of being turned and threaded readily, and of taking a good finish.

(b) Any bar may be rejected because of injurious defects or faults in manufacture at any time notwithstanding that it has previously passed inspection, it shall be returned to the manufacturer at the latter's expense. This clause shall not be taken to apply to materials fabricated after export.

PHYSICAL PROPERTIES AND TESTS.—6. The bars shall have the following physical properties

Tensile Test.—(a)

	Bars not over 0.75 in. (19 05 mm.) diameter or width across the flats.	Bars over 0.75 in. (19 05 mm.) and not over 1.50 in. (38 10 mm.) diameter or width across the flats.	Bars over 1.50 in. (38.10 mm.) diameter or width across the flats.
Minimum tensile strength	70 000 lbs./in.²	70,000 lbs./in.²	65 000 lbs./in.²
Minimum yield point	50 000 lbs./in.²	50,000 lbs./in.²	50 000 lbs./in.²
Minimum elongation in 2 inches or proportion gauge length	20 per cent.	17 per cent.	18 per cent.
Minimum reduction of area	40 per cent.	38 per cent.	35 per cent.
Minimum tensile strength	49.2 kg./mm.²	49.2 kg./mm.²	45.8 kg./mm.²
Minimum yield point	35.1 kg./mm.²	35.1 kg./mm.²	35.1 kg./mm.²
Minimum elongation in 2 inches or proportion gauge length	20 per cent.	17 per cent.	15 per cent.
Minimum reduction of area	40 per cent.	38 per cent.	35 per cent.

Bend Test.—(b) Bend test pieces from bars of 0.75 in. (19 05 mm.) or less diameter (or width across the flats) shall be tested in full size as rolled or drawn. Above 0 75 in (19 05 mm.) diameter (or width across the flats) the test pieces may be turned down from the bar to a diameter of 0 752 in. (19 08 mm.) The test pieces shall withstand bending cold through an angle of 180 deg over a radius equal to their diameter (or width across flats) without fracture.

SELECTION OF TEST SPECIMENS.—7 (a) The bars shall be grouped by heats or melts into lots conforming to the size limits given in paragraph 6. The inspector shall select at random 1 per cent, but not less than three bars of each lot to be representatives of the sizes in the lot. One tensile and one bend test specimen shall be cut from each bar.

(b) For sizes over 1 50 in (3 88 cm.) in diameter or width across the flats, one tensile and one bend specimen shall be taken from a bar of each size represented in the lot.

(c) The bars and specimens shall be stamped for identification. Whenever bars can not be grouped by heats or melts, one tensile and one bend test specimen shall be taken from each lot of 100 bars or less. The provisions as to grouping by size limits and provisions for bars of over 1 50 in. (3 88 cm.) diameter, as given above, shall apply.

(d) The specimens shall not be annealed or otherwise treated before they are tested. They are to be tested in full section unless the bars are to be subsequently reduced in section by machining. In this event, the tensile specimens may be machined to standard sizes in accordance with specification 1G1.

DIMENSIONS AND TOLERANCES.—8. The dimensions and tolerances shall be those given in the specification 3S11.

DELIVERY, PACKING, AND SHIPPING.—9 (a) All bars shall be suitably greased for protection against corrosion.

(b) The bars shall in general be grouped in bundles weighing not more than 220 lb. (100 kg), unless otherwise agreed between manufacturer and purchaser, the heat number and the I. A. S. B. steel serial number shall be plainly marked on a metal tag attached to each bundle. If bars are not so grouped and bundled, each bar shall be plainly marked with the heat and the I. A. S. B. steel serial number.

When electric or crucible furnace steel is specified in the order, the maximum allowable percentage of phosphorus and sulphur may, at the option of the purchaser, be limited to 0 03 per cent.

COMPOSITIONS OF STANDARD STEELS.

Number	Carbon.	Manganese.	Phosphorus, maximum.	Sulphur maximum.
1010	0 05-0 15	0.30-0.60	0.045	0 050
1015	.10-.20	.30-.60	.045	.050
1020	.15-.25	.30-.60	.045	.050

3N7—Specifications for Seamless Brass Tubes

GENERAL.—1. The general specifications, 1G1 shall form, according to their applicability, a part of these specifications.

USE.—2. This tubing is resistant to the corrosive action of salt water, salt air and gases.

MATERIAL.—3 (a) The brass shall have the following composition

	Per cent.
Copper	79.00 to 82.00
Lead maximum	.30
Iron, maximum	.10
Zinc	Remainder

(b) Samples for analysis may consist of turnings taken from the end of the tube or of drillings. Points from which drillings are taken must be distributed around the surface of the tube so as to yield a representative sample of the tube wall.

MANUFACTURE.—4 (a) The brass shall be made from lake or electrolytic copper conforming to the I. A. S. B specification 2N2 and from B or C grade spelter conforming to I. A. S. B. specification 2N8.

(b) No scrap shall be used other than that produced in the manufacturer's own plants and of the same composition as the material specified.

(c) Tubing shall be semiannealed unless otherwise specified.

(d) Any sheet may be rejected because of injurious defects or faults in manufacture at any time, notwithstanding that it has previously passed inspection, it shall be returned to the manufacturer at the latter's expense. This clause shall not be taken to apply to materials fabricated after export.

WORKMANSHIP AND FINISH.—5. The tubing shall be clean, smooth and free from all injurious defects, both inside and outside.

PHYSICAL PROPERTIES AND TESTS.—6. (a) *Flattening Test*.—A piece of tube, 2 diameters in length, shall be flattened with a hammer until it passes freely through a micrometer caliper set at three times the thickness of the tube wall. The tube must stand this test without showing cracks or other defects.

(b) *Expanding Test*.—A pin with a taper of one in eight shall be driven into one end of the tube until the tube's diameter is increased by one-sixth. The tube must stand this test without showing cracks, splits, or other defects.

(c) *Hydrostatic Pressure Test*.—Each tube shall be subjected to a hydrostatic pressure which will develop a tensile stress of 7000 lb per sq in. (4.92 kg./mm.²) in the tube, but in no case shall a test pressure of more than 1000 lb. per sq in. (0.703 kg./mm.²) be required. Each tube must withstand this test without cracks, flaws, leaks, or other defects such as bulging.*

SELECTION OF TEST SPECIMENS.—7. (a) Each tube shall be subjected to a hydrostatic test. One tube from each lot of 100 or less shall be subjected to a flattening and to an expanding test.

(b) If any tube fails to pass the flattening or the expanding test, two more tubes representing the same lot shall be subjected to both tests. If either of these tubes fail in either test the lot which they represent shall be rejected.

(c) Any tube failing to meet the hydrostatic test shall be rejected.

DIMENSIONS AND TOLERANCES.—8. (a) *Tolerances*.—The following tolerances shall be allowed on wall thickness and outside diameter

TOLERANCES FOR OUTSIDE DIAMETER AND WALL THICKNESSES

Outside diameter	Tolerances on outside diameter	Wall thickness.	Wall-thickness tolerance.
Inches	*Inch*	*Inch.*	*Inch.*
0-0 50	±0 002	0-0.0156	±0.001
0.51-.75	± .0025	0.0157-.0312	± .002
.76-1.00	± .003	.0313-.0625	± .003
1.01-1.25	± .0035	.0626-.1250	± .005
1.26-1.50	± .004	.1251-.2500	± .008
1.51-1.75	± .0045	.2501-.3125	± .0125
1.76-2.00	± .005	.3126-.3749	± .0150
2.01	±(.25%)		
Millimeters	*Millimeter*	*Millimeters.*	*Millimeter.*
0-12.70	±0.05	0-0.397	±0.03
12.71-19.05	± .06	0.40-.79	± .05
19.06-25.40	± .08	0.791-1.59	± .08
25.41-31.80	± .09	1.591-3.17	± .13
31.81-38.10	± .10	3.171-6.35	± .20
38.11-44.45	± .11	6.351-7.94	± .32
44.46-50.80	± .13	7.941-9.53	± .38
50.81	±(.25%)		

(b) *Length*.—When no length is specified, tubes may be shipped in stock lengths of 10 ft. (3.04 m.) to 14 ft. (4.27 m.). When ordered in definite lengths no length shall be less than that specified.

* The pressure to be applied shall be calculated from the formula $P = \frac{7{,}000\,T}{R}$

Where P = the hydrostatic pressure in pounds per sq. in.
T = the thickness of the tube wall in inches.
R = the internal radius of the tube.

Italian Airplane Record

Lieutenant Brachpepe of the Italian Army and a passenger recently attained a height of 7025 meters (23,048 ft.) in an Italian airplane, mounting to this altitude in 65 minutes.

On July 14, 1914, a German pilot named Oelerich attained a height of 25,756 ft., the record, however, not being passed upon by the Federation Aeronautique Internationale in Paris owing to the outbreak of the European war shortly afterward. H G Hawker, an English flier, reached a height of 23,622 ft. on April 26, 1916, at Hendon, England

Digest of the Foreign Aeronautical Press

Aeronautics (London), November 14, 1917

Supremacy of the Air.—Mr. Bonar Law, speaking on war achievements at the Free Trade Hall, Manchester, on Nov 7, gave the following facts about the work of the Air Service.

"In airplanes we had made immense advances. The number of airplane engines turned out last month was exactly three times more than in October last year. We had secured air supremacy on the front.

"Last September we dropped 1700 bombs upon places in the West from which enemy airplanes come. We did more damage to the enemy in that month than he had done in all the raids he had made upon England since the beginning of the war.

"We had a considerable number of machines bombing German towns, and, though it was only a beginning, more had already been done than the public realized."

Enemy Raid Admissions.—There has recently reached England a remarkably interesting book entitled "Deductions from the World War," by Lieutenant-General Baron von Freytag-Loringhoven, now stationed at Berlin as Deputy-Chief of the General Staff.

Freytag, in his chapter on "The Technical Developments of the War," has various interesting passages on aircraft and air raids. After remarking that airplanes have acquired a superiority over airships in land warfare, he says:

"The Zeppelins are extraordinarily sensitive. They have to keep at considerable heights, because they provide very large targets. This reduces the accuracy with which they can aim bombs. They also need a large expenditure of labor and materials, and they have to be housed in sheds. The brilliant innovation of Count Zeppelin provided a weapon which, especially at the beginning of the war, was of great moral importance, and was also of indisputable value, because with the Zeppelin we got over to England; but in this sphere also the large fighting airplane has taken its place. . . . Aviation, obviously, has a great future. Its possibilities of development are enormous."

As regards air raids, he remarks: "Unfortified places of no military importance have had to suffer. The bombardment of these places is in itself objectionable, but the limits of what is permissible are in this matter in many ways elastic. A new weapon opens up its own paths, as is shown, for example, by the submarine war. In any case, in this struggle of the peoples, with its economic background, the war is turned more and more against the enemy countries, and the principle hitherto accepted that war is made only against the armed power of the enemy is in this, as in other spheres, relegated to the background."

Aeronautics (London), November 21, 1917

A Zeppelin Surprise. By Jhadoo Jahan.—The writer examines the conditions which the Zeppelin airships had to fulfill, during their last raid on the British Isles, in order to reach the extraordinary altitude from which they delivered their attack.

For this purpose the author had at his disposal the following table of estimated weights of the Zeppelin L 49, which had been prepared by Mr Warner Allen

	Tons.
Hull framework	12
Outer cover and gas bags	1
Fins	1
Framework of cars	1
Power plant	5½
Fuel tanks	1½
Armament wireless	1½
Miscellaneous	1
Total	24½

The gross lift of the modern Zeppelin being assumed as 60 tons, it follows that 35½ tons remain available for "disposable weights," such as crew, fuel, bombs, and water ballast. Of this, 1½ tons are taken up by the crew, 5½ tons by the fuel supply, and 2½ tons by the bombs, so that the Zeppelin must carry in the neighborhood of 28 tons of ballast. The latter amount the Zeppelin fully needs for attaining the 20,000 ft. level, provided allowance is made for additional dynamic lift.

It will be seen that these figures closely tally with those computed in the Dec 15 issue of Aviation and Aeronautical Engineering, although there is necessarily a certain variance between the two estimates of weights of the structural parts of the Zeppelin

The Aeroplane (London), October 10, 1917

Reorganization of the German Flying Corps. By "Austerlitz."—Following the defeat of the Somme, the German Flying Corps was totally reorganized, as its inferiority to the Allied Air Services had been fully proven

There are at present four major tactical formations within the German Flying Corps, these are:

(1) Army squadrons
(2) Army corps squadrons
(3) Pursuit squadrons
(4) Battle wings

1. The Army squadrons are primarily employed for strategical reconnaissances, but may sometimes be detailed on photographic work, and even bombardments.

The machines forming the Army squadrons are two-seater tractor biplanes of from 41 to 45-ft. span, and are fitted with a stationary Benz or Mercédès engine developing from 225 to 240 hp. Their horizontal speed is from 100 to 105 m.p.h.

The armament consists of (1) two machine guns, one of which is mounted on a fixed emplacement in front of the pilot and fires through the propeller by means of a synchronizing device, the other machine gun is mounted on barbette, aft of the pilot, on the observer's seat; (2) one or two bomb gears, munitioned with four or six bombs.

2. The army-corps squadrons are assigned to tactical reconnaissance, photography, gun spotting, and, during active operations, contact patrol work between the units engaged in an advance

The army-corps squadrons are equipped with machines which are in every way similar to those forming the Army squadrons, except for a smaller power plant, which endows them with lesser speed

The armament is the same as on the Army squadron type. Provision is made on these machines for the quick exchange of the bomb gear against a radio installation or a photographic apparatus

3. The pursuit squadrons are assigned to the defense of the army-corps squadrons engaged in tactical reconnaissance work, but they are also employed, in some instances, on convoy duty with bombers and for the destruction of the Allied kite-balloons

There appear to be, at present, on the Western front about forty pursuit squadrons, each of which consists of twelve machines. In some instances two or more squadrons are combined into pursuit wings, which are placed under the leadership of particularly capable chiefs

A number of pursuit squadrons are detached to the local defense of important German towns.

The pursuit squadrons are equipped with one-seater biplanes of from 28 to 30-ft span, which are fitted with a 175 hp Mercédès engine driving a tractor screw. The horizontal speed of these machines is from 110 to 125 m p h, they are principally built by Albatros, Fokker, L. T. G. (Lufttorpedo-Gesellschaft), and Roland

The armament consists of two Spandau machine guns, mounted "fixé" in front of the pilot, which are synchronized to fire either simultaneously or alternately through the propeller. No bomb gear is provided

4. The battle wings are placed under the direct orders of General Headquarters, and are not, as a rule, permanently assigned to particular sectors

These wings consist of from forty to fifty machines, and are subdivided into four or five squadrons. The machines are mostly Gotha twin-pusher biplanes. A certain number of bomber squadrons are, however, equipped with A. E. G. twin tractor biplanes, and a huge Rumpler bomber will shortly be placed in commission, unless it is already in service

The Aeroplane (London), November 21, 1917

Germany's Air Chief.—In November last the whole air power of the German Army was united under the command of a single chief, General von Hoeppner, who had served through the Somme battle as Chief of Staff of General von Below's army. General von Hoeppner left the Somme fully convinced that the Allies owed their success to their superiority in the air, and he set to work instantly to redress the balance. It is to the energy and inventiveness of this officer that the

Germans owe the recovery of their air service that we have witnessed this year

General von Hoeppner's first business on assuming his post was to start a campaign in the army and in the country in support of air service. The Press was fed with suitable articles, interesting accounts of the feats of German airmen, etc., and an air war exhibition was held in Berlin. Young officers of other arms were encouraged to become air men. The results of all this advertising were highly satisfactory

Similar efforts have been made to improve and multiply the flying material of the army. Wherever a factory could be found with suitable plant not already making airplanes or airplane parts, General von Hoeppner pressed it into his service. To increase the output of the factories, types, both of airplanes and engines, were, as far as possible, standardized, and product was concentrated on the four types selected—the Albatros fighting machines, the Albatros observation two-seater, and the Deutsche Flugzeugwerke and General Electrical Company (A. E. G.) models. Similarly, attention was centered on the production of Benz and Mercédès engines, at first 100 hp., and later of 200 and 260 hp., to the neglect of other makes.

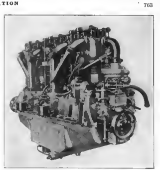
General von Hoeppner is the chief promoter of the Gotha machine, for which he has placed large orders with the Erfurt factory that builds them. Lately he has been supplying the battle squadrons with a large number of airplanes carrying two machine guns, and the observation machines have been improved in speed and armament

General von Hoeppner has done his utmost to bring his aerodromes up to the highest state of efficiency. The personnel is abundant. Each flight of six airplanes has in its service a complement of from 100 to 120 men. To each machine there are four mechanics, and every squadron has its own train of motor transport, motor-cars, etc. The aerodromes are protected as well as possible from air attack by anti-aircraft guns, of which the air service has no fewer than 600, including a large number of 4-in. pieces.

Flight (London), December 6, 1917

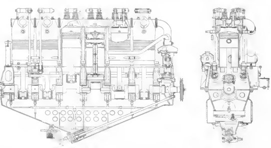
The 230 Hp Benz Aero Engine.—This engine embodies the usual German aircraft engine practice, that is, it is of the 6-cylinder, stationary, water-cooled type. In its constructional details it is virtually identical to the 160 hp Benz model that was described in the Dec 1, 1917, issue of Aviation

Each cylinder is bolted to the crankcase by long bolts and studs, which pass through the crank chamber top half and secure the crankshaft bearings between the top and bottom halves of the crank chamber



Rear End of 230-hp Benz Aircraft Engine

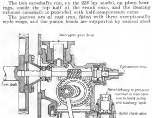
The cylinders are of cast iron, with built-up steel water jackets, the water-jacketed heads being cast integral with the cylinders. Two inlet and two exhaust valves are fitted in the cylinder heads, and are operated by overhead rocker arms working on ball bearings and by push rods on either side of the cylinders, whereas on the 160 hp. model the push rods were all on one side of the cylinders. (In the description above referred to, the valve mechanism of the 160 hp Benz was, on p 611, mentioned as being of the overhead camshaft type. This was a typographical error.—Editor.)



General Arrangement of the 230-hp Benz Aircraft Engine, 145 mm Bore by 190 mm Stroke

The two camshafts run, on the 230 hp model, on plain bearings, inside the top half of the crank case, and the floating exhaust camshaft is provided with half-compression cams

The pistons are of cast iron, fitted with three exceptionally wide rings, and the piston heads are supported by conical steel



OIL PUMP OF THE 230 HP BENZ ENGINE

forgings riveted and welded to the piston crown—an arrangement which is of the notable features of Benz practice

The bore of the 230 hp model is 145 mm, the stroke 190 mm Two separate two jet carburetors are fitted, each of which supplies three cylinders through an independent branched induction pipe, built up of light aluminum tubing

The lubrication is effected by a gear pump working in an auxiliary oil reservoir formed in the bottom of the base chamber An oil-sealed gasoline pump feeds the carburetors in conjunction with a supplementary pressure reservoir enclosed in the main gasoline tank This pump is driven off the rear end of the inlet camshaft. The same driving spindle also operates the machine-gun interrupter gear and the tachometer drive.

From the delivery of the pump gasoline is forced into the top of the pressure reservoir inside the main gasoline tank, and, rising in the reservoir, creates a cushion of compressed air above the gasoline, thus serving to damp out the pulsations arising from the action of the pump

In the earlier types the castor oil chamber was provided with an oil-filling cap, which was screwed into the side of the chamber casting, and was fitted with a special form of drain cock to determine the quantity of oil poured into the pump This filling arrangement has now been given up, and the annular oil chamber is fitted with a drain plug only

Flight (London), November 1, 1917

French and British Aero Engines.—The following data on French and British aero engines appeared in a German aviation magazine, the accuracy of the information cannot, therefore, be vouched for

The Renault firm of Billancourt, France, produces both water and air-cooled engines of the stationary V type. The air-cooled models have a bore of 105 mm and a stroke of 130 mm. The normal power of the 8-cylinder motor is 100 hp, and of the 12-cylinder motor 130 hp. The overall length of the 12-cylinder motor, from the back of the fan housing to the propeller, is 1,450 mm. While the 8 cylinder motor has only one carburetor, the 12-cylinder has two, one for each row In the 8-cylinder type the magneto is placed above the camshaft, while in the 12-cylinder motor it is placed with its axis at right angles to the crankshaft

The 240 hp 12-cylinder water-cooled model has been described in detail in the Aug 1, 1916, issue of AVIATION AND AERONAUTICAL ENGINEERING

The water-cooled Peugeot engine has a 180 mm stroke to 100 mm bore. Two exhaust valves and two inlet valves have, therefore, to be employed in each cylinder The cylinders are arranged in a Vee of 90 deg, and each row of four cylinders is cast en bloc Each row has its camshaft operating inlet and exhaust valves. The crank case is cast in one piece

The air-cooled English Daimler was particularly favored by the R A F These motors have become the standard type for the B.E.2 and gave pretty good results with those machines, considering the then prevailing conditions of loading and uses to which they were put This engine is built in two types, the 100 hp 8 cylinder and the 150 hp 12-cylinder

The cylinders are placed at an angle of 90 deg In the 150 hp 12-cylinder type the angle between the cylinders is smaller The cylinder design is the same as in the 8-cylinder type. While in the Renault the cylinders are held down by means of a four-armed yoke and four bolts, the cylinders of the English Daimler are only held by two bolts each Since thus the yoke over the top of the cylinder is avoided, it has been possible to provide extra fins on the top of the cylinder, running parallel with the crankshaft. The exhaust valves, as in the Renault, are placed above the inlet valves, and are operated by push rods and rockers The induction pipes are unusually short, thus avoiding the sharp bends found in the Renault engines. The magnetos are mounted on brackets on the propeller end of the engine

The 160 hp 6-cylinder, water-cooled Beardmore engine has steel cylinders with copper water jackets

FRENCH AND BRITISH STATIONARY ENGINES

Name	Cooling	No of Cyls	Bore	Stroke	R. P. M. Motor	R. P. M. Screw	Nom H P	Mean Piston Speed	Str'k Bore
Renault	Air	8	105	130	2 000	1 000	80	8 6	1 26
Renault	Air	12	105	130	2,000	1 000	130	8.6	1.28
Renault	Water	8	125	150	1 400	1 400	160	7 0	1.2
Renault	Water	12	125	150	1 400	1 400	240*	7 0	1.2
Peugeot	Water	8	100	180	?	†	?		1 8
Daimler	Air	8	100	140	2 000	1 000	100	9 3	1 4
Daimler	Air	12	100	140	2 000	1 000	150	9 3	1 4
Beardmore	Water	6	142	178	1,300	1,300	160**	7 7	1.25
Rolls Royce	Water	12	114	164	1 800	1 024	250‡	8 75	1 44

* 207 b h p

** 164 b h p. at 1 300 r p.m 168 h p at 1 400 r p.m.

‡ 280 b h p

† Half engine speed

The Aeroplane (London), November 28, 1917

German Airplane Design.—The September issue of the German aviation magazine, *Deutsche Luftfahrer Zeitschrift*, publishes an article on single seater fighting airplanes, in which the following phrases appear:

"The demand for surpassing the ceiling of the enemy aircraft made it necessary to increase the area of the airplanes, this being, however, possible no further in the monoplane model Thus the small-dimensioned, light biplanes were produced, keeping the monoplane body, and here again Fokker turned out one of the most successful types, differing from the other fighting biplanes by obtaining lateral control through warping, as against the ailerons of the others.

"The first Fokker biplane fighters had two sets of struts between the planes on each side of the body, but even though all parts were built light and small, our enemies, demanding of such high safety figures as we, turned out fighting planes which were, owing to their smaller weight, equal to our aircraft, at times even surpassing them

"This led to re-designing when but one set of plane struts was employed Thus the head resistance was also reduced, and the Fokker and Albatros, one-set strut biplanes, are still the most employed fighting airplanes. The competition with the airplanes of the enemies, steadily increasing in performance, has forced the German designers to shape all details in the fighting biplanes to least weight and highest reduction in head resistance, the foremost results being building the engines into the bodies, another object being to reduce the rudder and elevator areas to a minimum, some designs doing away even with fixed tail planes and fins, as in the Halberstadt type."

National Advisory Committee's Annual Report

Following is an extract from the annual report of the executive committee of the National Advisory Committee for Aeronautics covering its activities during the fiscal year 1916-1917

General Recommendations

In the latter part of March, 1917, when war with Germany seemed imminent, the committee, in conference with United States military and naval officers and manufacturers of aircraft, reviewed the condition of the aeronautical industry, the facilities then existing in this country for meeting the requirements of the Government, the possibilities of adequate expansion, and the then patent situation and its influence on the aeronautical industry

A subcommittee was appointed to cooperate with representatives of aircraft manufacturers and to investigate all problems entering into the quantity production of aircraft for the Government After a careful study of the conditions then existing the Advisory Committee submitted recommendations to the War and Navy Departments for increasing the quantity production of aircraft and urging the adoption of a continuing program of manufacture for the next three years.

In early April the chairman of the executive committee conferred with the Secretary of the Navy and the Secretary of War as to the best method to obtain the most efficient results in the development of aviation and the supply of aircraft for military and naval purposes, stating that the Advisory Committee deemed it desirable to create an aeronautical service with a civilian head, but not a distinct Government department This met the informal approval of the two secretaries and after a thorough study of the problem the committee recommended to the Council of National Defense that a board be appointed by the Council of National Defense, with the approval of the Secretary of War and the Secretary of the Navy, to be known as the Aircraft Production Board, whose duties would be to consider and deal with the problems arising in connection with the quantity production of aircraft in the United States for military purposes. The Advisory Committee further recommended that the Secretary of War and the Secretary of the Navy appoint a Joint Technical Board of the Army and Navy for determining specifications and methods of inspection for all aircraft requirements for the two services.

Ground Schools for Aviators

Supplementing the recommendation made to the Secretary of War and to the Secretary of the Navy that a continuing program be approved for the production of aircraft, on April 13 the committee recommended to the Council of National Defense that the several problems connected with the establishing of cadet training schools for aviators and with the production of aircraft should be considered together as interrelated problems and should also be considered jointly for the uses both of the Army and Navy.

The committee further, at the suggestion of and in cooperation with the War Department, took the initiative in organizing the several ground or cadet schools for the preliminary training of aviators in this country and in determining the curriculum and methods of carrying on this instruction.

To this end the committee took under consideration the different methods of training used by Great Britain and France.

On recommendation of the committee the War Department selected the following six colleges for the establishment of ground-school training in aeronautics Massachusetts Institute of Technology, Cornell University, Ohio State University, Illinois University, University of Texas and University of California Later Princeton University and Georgia School of Technology were added

Aeronautical Patents

In January, 1917, the War and Navy Departments called the attention of the Advisory Committee to the prohibitive prices of aircraft charged by the various aircraft manufacturers, attributing these prices to the extra item of royalty added by each firm in anticipation of infringement suits by owners of alleged basic aeronautical patents, who were then threatening all other airplane and seaplane manufacturers with such suits, and causing thereby a general demoralization of the entire industry

After numerous meetings with Government officials, owners of patents and aircraft manufacturers, the committee recommended the organization of an association among aircraft manufacturers for the purpose of cross-licensing aeronautical patents between the members, such association to be known as the Manufacturers' Aircraft Association.

The purposes in view in the formation of this association, and which it is believed have been achieved, are the following:

(1) The prevention of the virtual deadlock with danger of monopoly existing under the patent situation as obtaining previous to its consummation, and the removal of restraint upon the trade operative under the existence of such situation.

(2) The settling or avoiding of all litigation, actual and prospective, under the previously existing patent situation.

(3) The opening of the industry to free competition of all airplane manufacturers and the opening of all patents held by the membership of the association to equal use and on equal terms

(4) Provision, as set forth in the articles of agreement, whereby a design originating with a given manufacturer may be put into production and used by another manufacturer with all design data, drawings, specifications, etc., on the payment of a small fee, thus facilitating quantity production of an approved design and stimulating the production of new designs or processes.

(5) The development and financial stability and confidence in the airplane industry, thus making possible the financing of the absolutely needed expansion in order to take care of the expected demands.

(6) Reduced cost of aircraft to the Government by reduction of airplane royalties payable under all patents made available under the association to an amount less than one-half the figures previously demanded under a part only of these patents

(7) Broadly speaking, the encouragement of airplane production to the highest practicable degree and with reference to the demands of the Government under war conditions.

Information from Europe

In March, 1917, the committee arranged in conjunction with the National Research Council, for representation on the foreign committee sent abroad by the National Research Council to obtain detailed information on scientific matters of importance in connection with the war, and Dr Joseph S Ames, member of this committee, was appointed such representative.

In order to further develop contact with sources of information from abroad, Lieut. Col L. W. H. Rees, R F C, member of the British Commission, together with Maj Joseph Tulasne, Captain de Guiche and Capt. A de La Grange of the French Flying Corps and members of the French Commission, were made associate members of the committee, and as such attended its meetings, contributing valuable information and suggestions regarding matters with which they were especially familiar

Census of Production Capacity

Previous to the entrance of the United States into the present war, the committee had undertaken a census of the production facilities of manufacturers of aircraft and aeronautical engines, which information was made available for use of the Aircraft Production Board at the beginning of its work in April.

Site for Experimental Laboratory

In October, 1916, the committee took under consideration the question of the selection of a suitable site for the committee's proposed experimental laboratory

At the suggestion of the War Department, requesting recommendation by the Advisory Committee in the matter, this committee inspected several proposed sites and after making inquiries as to the general health conditions and the problems of accessibility to Washington and the larger industrial centers of the East, protection from enemy naval attack, climatic conditions, and cost of the site, it made recommendation to the War Department for the purchase of a site about four miles north of Hampton, Va., which recommendation was accepted by the War Department and the site was purchased

On this field the War Department has allotted to the committee a space suited to the erection of the committee's proposed research laboratories. The laboratory building is now in the course of construction.

The committee has also under preparation plans for the first aerodynamic laboratory to be installed at Langley Field intended for the development of high wind speeds. The work on this laboratory will be begun as soon as plans are ready.

Airplane Design and Materials

The committee has cooperated with the Aircraft Production Board in connection with a wide variety of problems relating to the design, specifications and tests of aircraft. The committee has now in hand (November, 1917) a most important investigation on the use of steel for airplane construction.

In connection with the subject of the materials for airplane construction, the committee has given its attention chiefly to the investigation of strut forms for airplanes, the strength of spruce bars and the development of cotton airplane fabrics as a substitute for Irish linen.

In the field of power-plant design and construction for aircraft, the committee has cooperated with the Bureau of Standards in the design, construction, equipment and operation of a large vacuum chamber engine testing laboratory, which is intended to reproduce the conditions of aeronautical engines operating at high altitudes. This equipment has been installed with special reference to the development and improvement of the "Liberty" engine, and important investigations bearing on this problem are now being carried forward. The committee has also carried on a number of researches on the subject of radiator design and proportion, carburetor design and adjustment and ignition apparatus, and is continuing its study of the problem of an airplane engine muffler.

Airplane Instruments

The committee has developed an improved form of geographic position indicator, which will be of special value in connection with certain free-flight tests under consideration.

Aircraft Communications

Regarding the subject of aircraft communications, the committee has cooperated in the development of a generator for wireless sending from airplanes and intended to satisfy the requirements of the Army and Navy. Means for receiving wireless signals in an airplane have also been investigated and it has been established that a very efficient receiving set employing the sound method is practicable. Investigations are still being carried on regarding means for detecting hostile airplanes before they are visible or before they can be heard by the unaided ear.

Mapping from Airplanes

On March 8, 1917, the committee took under consideration the development of methods for mapping from airplanes. Allotments were made for developing a new type of airplane mapping camera and gratifying progress has been made in the development of such an instrument.

Meteorology

In the field of meteorology, the committee recommended to the President an appropriation for the extension of the aerological work of the U. S. Weather Bureau, and in accordance with which an appropriation of $100,000 was made by Congress for the work.

In August, 1917, the Advisory Committee recommended that there be organized under the Chief Signal Officer of the Army, as a war measure, a military aerological service with necessary stations and equipment, both in the United States and abroad.

Board of War Inventions in Aeronautics

The committee, through an appropriate subcommittee appointed for the purpose, has acted as a board of inventions for the Government in matters relating to aeronautics, and since the outbreak of hostilities between the United States and Germany it has weekly examined hundreds of suggestions and inventions pertaining to this subject.

Definition of Technical Terms

During the year the committee has given further attention to the subject of the definition and standardization of technical terms used in aeronautics, and has prepared a further edition of its bulletin on the subject. (Technical Report No. 15.)

Metric System Adopted

On recommendation of the Advisory Committee, in December, 1916, the War, Treasury, Interior and Commerce Departments adopted the metric system of weights and measures for all drawings and calculations on aeronautical matters, for use with the accompanying English equivalents.

Aerial Mail Routes

In December, 1916, the subject of cooperation with the Post Office Department in the establishment of aerial mail routes was considered. Recently the Second Assistant Postmaster General has expressed a desire to develop such routes in a trial way and so far as military requirements may permit furnishing the needed equipment and personnel.

Civil Aerial Transport

In the latter part of 1917 a special subcommittee was appointed to take under consideration the various phases of civil and commercial uses of aeronautics with special reference to the conditions which may be expected to develop at the close of the war.

Landing Field for Transient Aviators

In connection with the accommodation of transient aviators, and in cooperation with the War Department, a tentative selection of a tract of land was made on the Eastern Branch and southeast of the Washington Navy Yard.

Technical Reports

The following is a list of technical reports which have been collected by the executive committee for publication in the third annual report (Reports Nos. 1 to 12, inclusive, were published in previous annual reports):

No. 13. Meteorology and Aeronautics.
No. 14. Experimental Research on Air Propellers.
No. 15. Nomenclature for Aeronautics.
No. 16. The Stretching of the Fabric and the Deformation of the Hull in Full Balloons.
No. 17. An Investigation of the Elements which Contribute to Statical and Dynamical Stability and of the Effects of Variation in those Elements.
No. 18. Aerofoils and Aerofoil Structural Combinations.
No. 19. Periodic Stresses in Gyroscopic Bodies with Applications to Air Screws.
No. 20. Aerodynamic Coefficients and Equivalents in Different Systems of Units.
No. 21. Theory of an Airplane Encountering Gusts, II.
No. 22. Fabrics for Aeronautical Construction.
No. 23. Aeronautical Power Plant Investigations.

Annual Report of the Chief Signal Officer

The work of the Signal Corps has included the development of the Army's air program, the installation, operation, and maintenance of the Army's military telegraph and telephone systems, and radio ship and shore stations, the installation and maintenance of annunciator-buzzer and other target-range communication systems, the supply of the signal unit accounts, the supply of equipment to the several components of the Army, and the supply of material for the maintenance of fire-control systems and radio and signal stations for coast defenses.

At the commencement of the fiscal year 1917 the Mexican border mobilization was in progress. The Signal Corps met its requirements for that additional work with some difficulty. After some months the situation was relieved by an appropriation for the air service, about ten times as great as the total amount appropriated for such service during the preceding four years. Additional increase in personnel through the Reserve Corps was also authorized and the corps given authority to proceed with the organization of units and the purchase of equipment to meet existing needs.

The Signal Corps had at its disposal at the outbreak of the present war the nucleus of its war personnel and complete information as to the possibilities of the material market, and with the assistance of the National Advisory Committee for Aeronautics, the National Research Council, and the Council of National Defense, immediately acted to meet the emergency. Conditions made necessary a special air program. Congress approved of the air program and the bill was signed by the President July 24, 1917.

Following is a statement of the Government boards directly associated with the office of the Chief Signal Officer, the several divisions necessarily established in that office to meet existing conditions, and a general statement of the duties of each:

Council of National Defense—Aircraft Production Board

This board was established by resolution of the Council of National Defense of May 16, 1917, to consider matters relating to the quantity production of aircraft in the United States and to cooperate with the Army and Navy in furthering their air programs. In its advisory capacity the board has rendered invaluable aid to the Signal Corps.

Joint Army and Navy boards on aeronautical cognizance, design and specifications, Zeppelins, and on technical aircraft were created and have insured the desired cooperation between the War and Navy Departments.

Air Division

This division of the office of the Chief Signal Officer of the Army has general supervision over all matters pertaining to aviation. It handles all matters of design and development of airplanes, the selection, training, and commissioning of the officers of the aviation section, the recruiting and organizing of its enlisted personnel for duty at home and abroad, the training of aviators and the conduct and operation of aviation schools and stations.

The following table shows the sum appropriated for Army aviation purposes:

1912	$125,000
1913	100,000
1914	125,000
1915	250,000
1916	300,000
1916-17 urgent deficiency	500,000
1917	13,281,666
1917-18 urgent deficiency	43,450,000

On July 1, 1916, twenty-three officers of the Regular Army had completed their training in aviation and were serving on duty with the aviation section of the Signal Corps. Twenty-six other officers were under instruction. A small number of firms was making airplanes or airplane engines. With one or more exceptions practically none of these were producing more than an occasional machine, and most of the product had been contracted for by foreign governments. Five officers were in Washington charged with the duty of overseeing the expansion of the aviation section of the Signal Corps.

The problem of the fiscal year 1918, therefore, was the problem of preparing a general plan of development, of securing the cooperation of the aeronautical industry and insuring its expansion, and of solving the innumerable scientific and engineering problems which must be met to send men and machines into the air to reconnoiter and to fight over unmapped country.

Many weeks were required to remove the obstacles in the way of obtaining suitable airplanes and airplane engines in large quantities.

Specifications of various types of machines were prepared by a board of technically trained officers assisted by consulting engineers from civil life; the facilities of the Bureau of Standards were used for the testing of various materials, and devices of all sorts which might increase the military efficiency of the aviator received trial.

The money provided by Congress for the purchase of a site for an aeronautical experimental station was used in the purchase of Langley Field at Hampton, Va. This site, ideal for both land and water flying, was selected after a thorough canvass of available tracts.

The national defense act of June 3, 1916, authorizing the organization of an Officers' Reserve Corps and an Enlisted Reserve Corps was made the basis for training a reserve civilian personnel of flyers and mechanics, and a system of instruction was adopted which, with amplification and modification, is forming the basis of the instruction of war pilots.

When, in April, the United States entered the European war the Chief Signal Officer availed himself of the offers of a number of civilian experts to assist him by advice in meeting the problems of expansion which confronted the aviation service. Representatives of other Governments at war were also consulted and, as a response, experts in every line of aeronautical work were sent to Washington, so that the combined experiences of three nations became available to the United States.

Although training machines could be obtained, the war airplane with its refinements of construction and its engines of unprecedented efficiency was practically unobtainable in the United States in April. The Liberty engine, which for power, lightness, and efficiency compares favorably with the best European types, was under development in June.

By the end of June, 1917, the number of Regular Army officers trained and detailed to aviation duty had been increased from twenty-three to ninety-two, and in addition fifty-four civilians had qualified for commissions in flying capacities in the Signal Reserve Corps. The system of training civilians for commissions had been amplified by the organization of eight schools of military aeronautics, where prospective officers could receive schooling in military discipline, the principles of airplane and engine construction and operation, radiotelegraphy, photography, bombs and bomb dropping, and aerial observation, and at the close of the fiscal year many student officers were under instruction.

The program of action made possible by the Congressional appropriation that became available July 24, 1917, had been practically mapped out before the end of the fiscal year.

Equipment Division

The fiscal year 1917 has shown an abnormal expansion of the work of the equipment division, due to the declaration of war. Many problems of supply and finance have arisen. The formation of many new organizations and the increase in the allowance for such organizations has made it necessary for the corps to secure enormous quantities of mobile army equipment.

Standardization in the types and production of airplanes and airplane engines was initiated with the cooperation of the manufacturing industries of the country. This has involved the reconstruction of factories, in most cases the installation of entirely new equipment and the development of a new organization.

The following shows the disbursements from Signal Corps appropriations during the fiscal year 1917:

Appropriation	Amount	Disbursements	Balance unexpended
Signal Service of the Army 1916-17	$250,000 00	$250,000 00	
Signal Service of the Army 1917	9,781,766 06	9,781,766 06	
Signal Service of the Army 1917-18 act June 17 1917	47,267,756 00	23,504,470 75	$23,763,285 25
Signal Service of the Army (no year)	4,500,000 00		4,500,000 00
Aviation, seacoast defenses	1,000,000 00	120,589 02	879,410 98
Aviation, seacoast defenses, insular possessions (Hawaii)	600,000 00	161,322 03	438,677 97
Aviation, seacoast defenses, insular possessions (Philippines)	400,000 00	21,889 04	378,110 96
Aviation, seacoast defenses, Panama Canal	300,000 00		300,000 00
Maintenance, etc., fire-control installations at seacoast defenses	136,792 56	135,353 15	1,439 41
Maintenance, etc., fire-control installations at seacoast defenses Panama Canal	10,000 00	9,349 32	650 68
Maintenance, etc., fire-control installations at seacoast defenses, insular possessions	10,653 92	10,647 34	6 58
Washington-Alaska Military Cable & Telegraph System 1917-18	30,000 00	30,000 00	
Seacoast installations on Mexican border 1916-17	60,000 00	60,000 00	
Commercial telephone service at Artillery posts 1917	6,500 00	6,500 00	

The following shows the disbursements made from allotments to the Signal Corps during the fiscal year 1917:

Appropriation	Amount	Disbursements	Balance unexpended
Fire-control installations	$404,436 50	$378,536 31	$25,900 24
Board of Ordnance and Fortification	24,801 69	873 70	23,927 99
Equipment of Coast Artillery armories, Organized Militia	699 75	699 75	
Field Artillery for Organized Militia, 1916-1917	11,588 47	11,588 47	
Arms, uniforms, equipment, etc., for field service, National Guard, 1917	342,227 90	342,227 90	

News of the Fortnight

Unification of the British Air Services

The unification of the British air services under a single head responsible to Parliament, which has been a long-standing topic in the English press, is now an established fact.

The Air Force Act, 1917, the bill for which was introduced in the House of Commons on Nov. 8 by the Government and passed by both houses in the latter part of November, provides for the establishment of an Air Force, equal in status with and independent of the Navy and the Army, in which the present Royal Naval Air Service and the Royal Flying Corps will be absorbed.

The Air Force Act further provides for the establishment of an Air Council, equal in status with and independent of the Board of Admiralty and the Army Council, which will take the place of the present Air Board. The president of the Air Council is to be a Secretary of State and will hold a position analogous to the First Lord of the Admiralty and the Secretary of State for War. He will be directly responsible to Parliament for all questions involving the personnel and material of the Air Force, and the manufacture, design and equipment of aircraft. While the Air Board is only a consultative body, the Air Council will possess executive power. At present it is proposed that the Air Council shall consist of a Secretary of State, a Chief of Staff, a Sub-Chief of Staff, and two officers who shall be responsible for the personnel and the materiel, respectively.

The Air Force Act also provides for the establishment of an Air Force Reserve and an Auxiliary Air Force, which will have a status similar to that of the Royal Naval Reserve and the Territorial Force.

Miss Stinson in Record Flight

Miss Katherine Stinson established a new American non-stop record for airplane flight on Dec. 11 by flying from San Diego to San Francisco, and covering the distance of 610 miles in nine hours and ten minutes.

Miss Stinson suffered somewhat from the cold, due to the high altitude at which she flew, but otherwise she experienced little discomfort on the long trip. In crossing the Tehachapi mountains, in southern California, she reached her highest altitude of the journey—9,000 ft.

Miss Stinson's flight beats the previous non-stop record of 512 miles, made by Miss Ruth Law, Nov. 19, 1916, between Chicago and Hornell, N. Y.

Miss Stinson started at 7.31 a. m., from the North Island Aviation Grounds at San Diego and arrived at the Presidio Military Reservations at 4.41 p. m. The flight was made in a triplane.

Government Is Using Motor Plant

That part of the machinery and plant of the General Vehicle Co. of Long Island City, N. Y., which is being utilized to turn out the Gnome-monosoupape airplane engine, has recently been taken over by the Government. The company makes the following announcement:

"With respect to certain rumors regarding the General Vehicle Co., Inc., it may be authoritatively stated that while a considerable portion of the Long Island City plant will be devoted to other work than the manufacture of electric trucks, the General Vehicle Co., as well as its manufacture of electric trucks, will continue utilizing such portions of the Long Island City plant as may be necessary for the purpose of continuing its business of nearly seventeen years."

Offer Bonus to Speed Spruce

As a means of speeding up the production of spruce to be used for military airplanes, Col. Brice P. Disque, Signal Corps, U. S. A., in charge of spruce production at Portland, Ore., announced recently that the Government would pay a substantial bonus on all deliveries prior to Feb. 28, 1918, and at the same time announced a new and higher price per thousand feet.

The price was fixed at $90 per thousand feet f. o. b. at the point of inspection, plus a bonus of $40 per thousand feet for all pieces accepted up to Jan. 31, and a bonus of $30 per thousand feet for all accepted up to Feb. 28.

Col. C. G. Edgar Has Been Promoted

Lieut. Col. C. G. Edgar, U. S. A., who is in charge of the Construction Division of the Aviation Section has been promoted to be a colonel with rank dating from Dec. 1.

Secretary Daniels on the Naval Flying Corps

In his report to the House Sub-Committee of the Naval Affairs Committee as well as in the discussion which followed, Secretary of the Navy Daniels gave the following information regarding the expansion of the Naval Air Service.

The increase in the naval aircraft material has been approximately 1,400 per cent., in personnel, 3,000 per cent., in stations and training schools, 3,200 per cent, and better results are steadily obtained. An estimate of 10,000 machines and 5,000 aviators is well within the correct number to be expected for next spring.

The naval aircraft factory at Philadelphia which was completed within ninety days, is about 400 ft. long and has a floor space of approximately 140,000 sq. ft. It is expected to produce something like 1,000 machines a year of the smaller type, or perhaps one half that number of the larger type, when in full operation. In addition to relieving other manufacturers for Army work, the naval aircraft factory will conduct experimental work. The production end will also supply the Navy with correct figures as to the cost of machines and so protect the service as to expenditures.

Report of the Forester

In the annual report of the Forest Service of the United States Department of Agriculture it is stated that over 500 tests were made from Sitka spruce, white oak and yellow birch to determine the influence of drying and steaming on strength, with particular reference to use in airplanes.

Kiln-drying tests previous to the entrance of the United States into the war continued along the same lines as in the past. Encouraging tests on structural sizes of Douglas fir show the possibility of kiln drying without appreciable loss of strength. A method was perfected under which hemlock shiplap can be dried to shipping condition with practically no degrade in forty to forty eight hours, and 2-inch plank in from four to six days. Douglas fir and red and white fir were also dried to practically a perfect condition in forty eight hours. The time for drying maple last blocks was reduced from twenty-one to two months, and losses reduced from an average of about 15 per cent. to 6 per cent. Green basswood was satisfactorily dried in 2-inch thicknesses in thirteen days and 1 inch thicknesses in nine days. Dogwood sticks and iron-wood blocks were dried in comparatively short periods without checking or honeycombing.

No Aero Show to Be Held

The Organization Committee of the Second Pan American Aeronautical Exposition announces that in order to keep clear of any possibility of adding to the congestion in transportation facilities of the country, it has decided to postpone the exposition, which was to be held at the Grand Central Palace beginning Feb. 16.

As the entire purpose of holding the show was to assist in carrying out the aerial program by the process of education outlined in the first announcement of the exposition, the committee feels that it can carry out such a program by holding a series of aeronautical conferences instead of holding the show.

Report of the U. S. Naval Observatory

In his annual report to the Bureau of Navigation, Rear Admiral Howard, U. S. N., retired, superintendent of the Naval Observatory, refers to aviation instruments as follows:

In conjunction with the station at Pensacola and other commands engaged in flying, the observatory has practically accepted as standard an altimeter (altitude aneroid barometer) and a clock. A compass for aircraft has been adopted and issued but is not proving entirely satisfactory and further experiments are under way.

One form of statoscope for dirigibles has been found satisfactory for certain purposes and will be issued to each dirigible when delivered. This is the Custer type. This instrument is non-luminous and does not indicate speed or amount of change of height. The observatory is assisting various inventors and makers of instruments to devise a statoscope that will answer all requirements.

The observatory has on hand a small number of airplane cameras of acceptable design. These are not fixed in the car and their value will have to be determined in service. Other forms of cameras are under trial.

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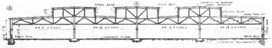
Pittsburgh	House Building	Court 1921
Philadelphia	Bulletin Building	Spruce 1281 / Race 401
Washington	Bellvue Hotel	Main [illegible]



This section shows how Austin Standard No. 3 Building can be extended laterally to any required width. From the point A to point B, leaving out the monitor under B, is the original Standard Cross Section. In the building shown above, the width was 900 feet.

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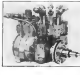

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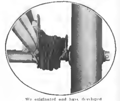

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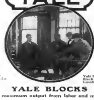

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